Interfacing Simulations with Training Content

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ABSTRACT

Recent years have seen huge increases both in computing power and the number of people able to access computers and the Internet. This proliferation of information and communication technologies has enabled higher quality learning to be made available through increasingly sophisticated modes of presentation. Traditional or conventional training programs use a variety of instructional development strategies to support a student's need to master a variety of competencies. Simulations and games are increasingly being deployed as powerful and valuable extensions to these traditional educational initiatives.

However, learning is a comprehensive process which does not simply consist of the transmission and learning of content. While simulations offer the opportunity to undergo informative interactive experiences, they do not, by themselves, constitute training or instruction. Assessment, student tracking and feedback are important elements in the teaching and learning process.

Recognizing the importance of these requirements, two IEEE standards committees have formed a collaborative study group to investigate the potential of formalizing a standard set of technical specifications to allow simulations and/or games to be launched and managed through SCORM-conformant content and Learning Management Systems.

This paper and presentation will focus on discussions, both technical and pedagogical; to address the many issues associated with developing such SCORM-Simulation Interface standards. Discussions will focus on the different use cases for simulations and the key interface points between simulation content and LMS environments such as delivering simulation content to the learner, monitoring key interactions and performance within simulation content and determining what the student should next experience within the continuum of training.

Additional information may also be found at the SCORM-Sim Interface standards study group section of the SISO website at http://www.sisostds.org

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ABOUT THE AUTHORS

This paper is a product of the many contributors to the SCORM-Sim Study Group of the Simulation Interoperability Standards Organization (SISO). The officers of this group are:

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PREFACE

The technologies used for Modeling, Simulation and gaming have great potential to become powerful and valuable extensions to traditional educational initiatives. Cognitive skills can be practiced and honed as students interact with models, simulations and virtual environments and research shows that people perform better after instruction when they have learned in the context of doing [1]. However, these technologies are only part of the mix of learning strategies that must be experienced by the learner in order to create a well educated individual.

Student tracking and assessment are important elements in the learning process and play a key role in determining when the student is ready to proceed to a more challenging level of training [2,3,4]. The combination of using advanced modeling, simulation and gaming techniques with the advanced learner tracking capabilities of a Learning Management System (LMS) has great potential to increase the efficacy of these technologies while reducing costs and optimizing performance.

This paper will discuss the progress of a collaborative IEEE/SISO study group assigned to study the underlying technology and methods of using modeling, simulation and gaming technologies within a SCORM-managed learning environment. The study group has solicited and collected position papers from Industry, Academia and Government. This call was met with an International response. A primary focus of the group is to compile these papers to document potential use cases, identify common architectural components and recommend any potential standards necessary to facilitate this integration. This paper represents a status report on this effort and will summarize the group's initial review of these position papers. It also discusses potential areas for standards development, the future focus of this group and an associated roadmap for how this integration may be accomplished.

OVERVIEW

The delivery of web-deployable training content has been standardized under the Advanced Distributed Learning (ADL) Initiative and is becoming very popular and widespread throughout the world. A key element of this effort is the SCORM specification, a set of standards to define the interface between a Learning Management System and learning content.

Within the SCORM context, the term LMS implies a web server-based environment in which the intelligence resides for controlling the delivery of learning content to students. This involves managing student information, delivering content, monitoring key interactions and performance within the content and then determining what the student should next experience. In the future, instructional strategies will include a range of training systems, simulations and devices in a range of different use cases.

The purpose of SCORM is to provide a means for interoperability between learning content, in the form of Sharable Content Objects (SCOs) and LMSs. For this to be possible, there must be a common way to launch content, a common way for content to communicate with an LMS and predefined data elements that are exchanged between an LMS and content during its execution. As presently defined, a SCO can be an entire course, a lesson within a course, or a topic within a lesson. SCORM is presently focused on packaging these objects to enable a "Learning Object" approach to training. In SCORM, learning content can be described, sequenced, tracked and delivered.

When evaluating games and simulations as a form of learning content, we will often find more complex requirements for delivering, initializing, launching tracking and management than what is currently possible within SCORM. Complicating this further, are the many types of simulations and many methods for how they are used.

The SCORM Content Aggregation Model

Empirical studies such as those summarized in Perrin et al. [5] and described in Perrin et al. [3,4] have shown that an optimum learning approach is to create learning strategies that conform to the evolving skill level of the student and provide various types of feedback on performance. In the SCORM 2004 environment, content objects do not determine, by themselves, how to traverse through a unit of instruction. Instead, the LMS processes "Sequencing and Navigation" (S&N) rules using results from the content objects to determine the order in which a student will experience learning resources.

The SCORM Content Aggregation Model (CAM) describes the methods used to assemble and sequence learning resources for the purpose of delivering a desired learning experience. A learning resource is any representation of information that is used in this learning experience. In order to use interactive models, simulations and games as learning resources, a method of integrating them into the SCORM paradigm is necessary. A key enabler being looked at as one potential area for standards development is a mechanism of describing, launching and initializing these simulation resources from content objects or directly by the LMS.

The SCORM Run-Time Environment

The SCORM Run-Time Environment (RTE) Document specifies the launch of learning content, communication between content and an LMS, data transfer, and error handling. When the focus is shifted to interactive simulations specifically, the issues involved are greatly amplified. There are many types of simulations with varying levels of interactivity and complexity. Simulations range from full motion or fully immersive simulators and multiplayer distributed games to simple user interface "surface simulations." They can be resident in a client browser or embedded into a separate system. Adding to the difficulty is the fact that often a simulation's resources require auxiliary processes and systems that must be initialized, configured and available for a simulation-based application to launch.

The LMS in the SCORM architecture is required to operate in a web-based server/browser infrastructure to deliver and receive communications from web pages. Therefore, the LMS has no inherent capabilities to directly launch or communicate with a native application session running on the client or other machine. One common approach presented to the study group was to use a Java applet or ActiveX component embedded in an HTML web page of the learning content to launch a simulation.

Many of these approaches also used an applet or component to create and manage a message pipeline between the simulation and the LMS. In the SCORM environment, the LMS is responsible for establishing a "handshake" with the client browser for the exchange of data during each learning session. Communications from the content to the LMS are accomplished using ECMAScript, which can be used to "set" and "get" data values on the LMS server using the SCORM-conformant Application Programming Interface (API) provided by the LMS.

The SCORM RTE defines a specific data model, which is the required vocabulary that must be used when communicating with the LMS. These "assessment modules" collect messages from the simulations which are translated into assessment information that an LMS can understand. This process was implemented differently across the position papers. Many approaches used an HLA federate to allow the assessment module to subscribe to published events from the simulation. Others used a similar approach without using HLA.

Joint ADL Co-Laboratory's Integrated Prototype Architecture - 2012

While the approach of using a Java applet proves adequate in many cases, there were concerns expressed from the Military members of the study group about the security considerations of using Mobile Code to launch, initiate and communicate between the simulation and the LMS. With the introduction of the 2012 – Integrated Prototype Architecture (IPA), the Joint ADL Co-Laboratory has introduced a new SCORM object called a "Lightweight Scenario Format (LSF)" file. The Co-Lab is careful to mention that the LSF is ***not*** intended to be a common configuration file format with the ability to initialize a simulation. Rather, the LSF file specifies how a particular simulation should be configured to support the objectives of a course.

LSF files are represented using an XML-based syntax and contain high-level information that can describe key elements of a simulation scenario. These elements are similar to those which are described by the DARWARS OCM model – Objectives, Conditions, and Measures.

- Objectives can be correlated with IMS Simple Sequencing objectives.
- Conditions can describe start-up factors like equipment types, locations, environmental factors, etc.
- Measures describe assessable factors which can be used to provide values to objectives.

The IPA-2012 is built around the concept of a Distributed Training Event Coordinator (DTEC) that works with an LMS to assist users in the process of locating and initializing the best, most accessible training system that is available to them at any given moment. This process starts with embedding an LSF file within a piece of courseware.

The DTEC follows closely the work of the DARWARS initiative and is envisioned as a companion to existing LMSs, not a replacement. Rather than attempting to embed a simulation within a SCO, the SCO might refer instead to a set of objectives, conditions, measures or a specific simulation, and delegate responsibility for managing this element to a local instance of the DARWARS Core. This linkage would mediate the exchange of information between the LMS and identify simulation scenarios that are appropriate for the unfolding learning event.

When the user is ready to begin executing a simulation, the LMS initiates a DTEC-provided "lobby." This is essentially a web page which offers a brief idle period during which simulation participants can gather. The lobby provides learners with a smooth transition from an asynchronous to a synchronous learning environment. When all roles have been filled, the DTEC initializes the simulation and waits for measures to be reported. These measures are passed back to the originating LMS where they are used to assign values to Simple Sequencing Objectives.

COMMUNICATIONS AND DATA MODELS

Security implications for web browser/server architectures limit how an LMS interacts with learning content; consequently, the LMS is not able to "watch" what is happening inside a simulation and take immediate action.

Figure 1 shows key elements and interfaces that have emerged from the study group discussions. This diagram is color coded. Yellow is used to represent simulation-related information.

A stand-alone simulation takes initial conditions and produces events.

In the SCORM context, the Learning Management System (shown as the blue oval) is responsible for managing three forms of data (shown in medium blue):

- Learner data, including learner identification and learner assessment records.
- Competency information, shown here in terms of tasks, conditions, and standards, but possibly including other forms, such as learning objectives.
- Content, the traditional SCOs, typically HTML-based data.

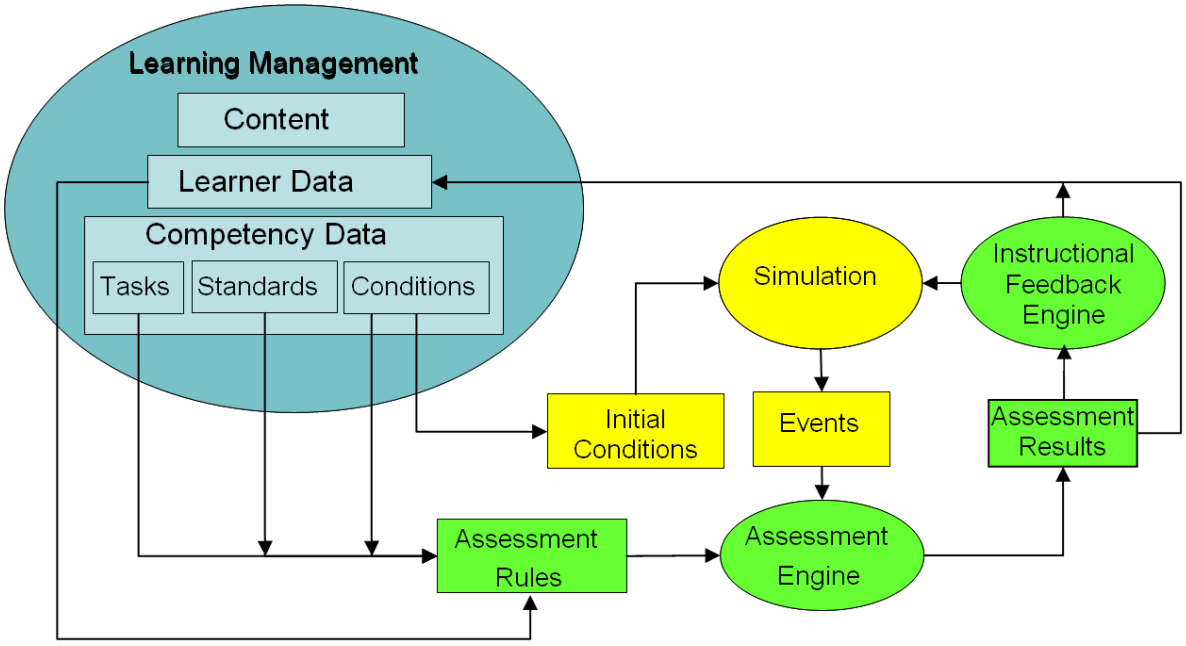

Figure 1: Overview of LMS and Simulation Interfaces

The new piece is the assessment engine, which takes Assessment Rules (an algorithmic form of policy) and streams of Events generated by the Simulation, and generates Assessment Results.
The arrows shown in this diagram are natural locations for interface specifications. The Distributed Interactive Simulation (DIS) and HLA standards already provide standard data models for event streams. A couple of other SISO groups are working on standards for Initial Conditions. SCORM 2004 provides standard specifications for Assessment Results and rollup functions to aggregate assessment results. However, the least well understood interface is the process of linking Competency Data to Assessment Rules and Initial Conditions. Furthermore, there is a need for managing the interaction between these subsystems and for configuring a learning system by distributing these functions over multiple resources in the context of restrictive computer networks.

In order for a SCORM-based LMS to track student performance during a simulation, the data communicated to the LMS must be confined to the data model that SCORM provides. Dodds & Fletcher [6] state that "*SCORM presently provides a rules-based 'learning strategy' that enables Sharable Content Objects (SCOs) to set the state of global records called objectives. These records can store the learner's degree of mastery in the form of a score or a pass/fail state….. A 'hook' was included in the record that permits them to reference externally defined competencies. As the learner is sequenced through the SCOs, the learning system builds up a representation of the learner's mastery and progress. The objective records may be viewed as a simple model of the learner's state (Gibbons & Fairweather, 1998).*"[6,7]

Generally speaking, a simulation will typically contain a number of "objectives", and learner progress toward each objective is tracked. To do this, a simulation has the potential to generate massive amounts of data that characterize the complex relationships between interactions for each objective. A method of hierarchically organizing simulation events, task steps, supporting skills and training objectives needs to be articulated such that a student's actions can be compared with a rule-based model of assessment.

While a simulation may track many assessment variables internally, it needs to be able to combine these variables into data values that an LMS is able to understand. This appears to be a common consideration across the study group and has been identified as an area that warrants further investigation for the development of potential standards. As shown in the above figure, there is a mechanism to listen to events or messages from a simulation, process them, translate them into data that an LMS can understand and communicate them to the SCORM data model either through the LMS or via web services.

OTHER APPROACHES & INITIATIVES

As the assessment component processes events from the simulation, there is potential to collect other contextual information that can be used as evidence to support competency. From an instructional effectiveness point of view, the capture of this information could greatly increase the effectiveness of simulations by allowing a more in-depth review of what a student has and hasn't mastered.

Dodds & Fletcher [6] further state that "*Another emerging specification called IMS Reusable Definition of Competency or Educational Objective (2002) defines a means of building a taxonomy of competency definitions that meet specific objectives. This taxonomy may be organized hierarchically to represent dependencies, supporting skills, or prerequisites. Each competency definition has a text description of the competency and a unique identifier that may be referenced externally. The organization of a competency definition could represent specific skills or knowledge to be acquired for a specific task or subject domain (e.g., as one might find in Quantitative Domain Mapping). Since objectives records in SCORM can reference the Competency model identifiers, the means to compare the state of the learner and the desired competencies now exists. This capability provides a system-based means to perform skills gap analysis leading to more sophisticated and adaptive strategies that use such information (Wiley, 2000).*"

STANDARDS AND SPECIFICATIONS

IEEE LTSC

The IEEE Learning Technology Standards Committee (LTSC) (http://ieeeltsc.org) is chartered by the IEEE Computer Society Standards Activity Board to develop accredited technical standards, recommended practices, and guides for learning technology.

Active LTSC standards and standards projects include standards for:

- Learning Object Metadata
- Communication between Learning Management Systems (LMS) and content
- Encapsulating definitions of competencies
- Practices concerning digital rights expression languages
- Content aggregations
- Simulation Interface Standards

Currently, three of the five components of SCORM 2004 (Metadata, Communications, and Content Aggregation) are based on LTSC standards, while a fourth (Competency) is in progress.

The LTSC coordinates formally and informally with other organizations that produce specifications and standards for similar purposes. Standards development is done in working groups via a combination of face-to-face meetings, teleconferences, and exchanges on discussion groups. The LTSC is a Category C Liaison Organization with ISO/IEC (JTC 1) Subcommittee 36 (SC36) for the development of learning, education, and technology standards. The LTSC is governed by a Sponsor Executive Committee (SEC) consisting of working group chairs and elected officers as described at http://ieeeltsc.org/.

The IEEE LTSC is currently going through a balloting process on a specification for "Standard for Reusable Competency Definitions" [8]. This standard is motivated in part by a growing international movement (led by the Human Resources community) to look at the bigger picture of expressing objectives and relationships among them. At issue is how to express the fact that one objective (or competency) might be "composed" of several sub-objectives and how to express ways in which data on sub-objectives can be "rolled up" [9]. There is also a focus on being able to reference existing taxonomies to create competency definitions.

The "Computer-Managed Instruction" (CMI) working group within the LTSC has been actively pursuing standards related to SCORM, including one that is defining a nomenclature and a conceptual model for digital aggregates of resources for learning, education, and training applications. The motivation for this is that different domains (multimedia, libraries, learning technology, technical documentation, etc.) have all created standards for "packaging" digital resources, metadata about the resources, instructions for using the resources, and other information. The DARWARS Training Package is a good example. The LTSC activity, known as RAMLET, is an attempt to help training systems make use of content that is packaged in different formats and to exchange training content with systems from other domains.

SISO

The Simulation Interoperability Standards Organization (SISO) originated over ten years ago with a small conference held April 26 and 27, 1989, called, "Interactive Networked Simulation for Training." The original conference attracted approximately 60 people. The group was concerned that there was activity occurring in networked simulation, but that it was occurring in isolation. The group believed that if there were a means to exchange information between companies and groups that the technology would advance more rapidly. The group also believed that once the technology begins to stabilize then there would also be a need for standardization. The technology and the consensus of the community would be captured in the standards as networking or simulation technology matured.

SISO is (now) an international organization dedicated to the promotion of modeling and simulation interoperability and reuse for the benefit of a broad range of M&S communities [10]. SISO's Conference Committee organizes Simulation Interoperability Workshops (SIWs) in the US and Europe. SISO's Standards Activity Committee develops and supports simulation interoperability standards, both independently and in conjunction with other organizations. SISO's Standards Activity Committee (SAC) is recognized as a Standards Development Organization (SDO) by NATO and as a Standards Sponsor by IEEE responsible for the development and maintenance of the IEEE 1516 series, High Level Architecture (HLA), and IEEE 1278 services, Distributed Interactive Simulation (DIS). In addition, SISO is a Category C Liaison Organization with ISO/IEC (JTC 1) for the development of standards for the representation and interchange of data regarding Synthetic Environment Data Representation and Interchange Specification (SEDRIS). Details about SISO's activities and opportunities to participate can be found on the SISO web site, http://www.sisostds.org.

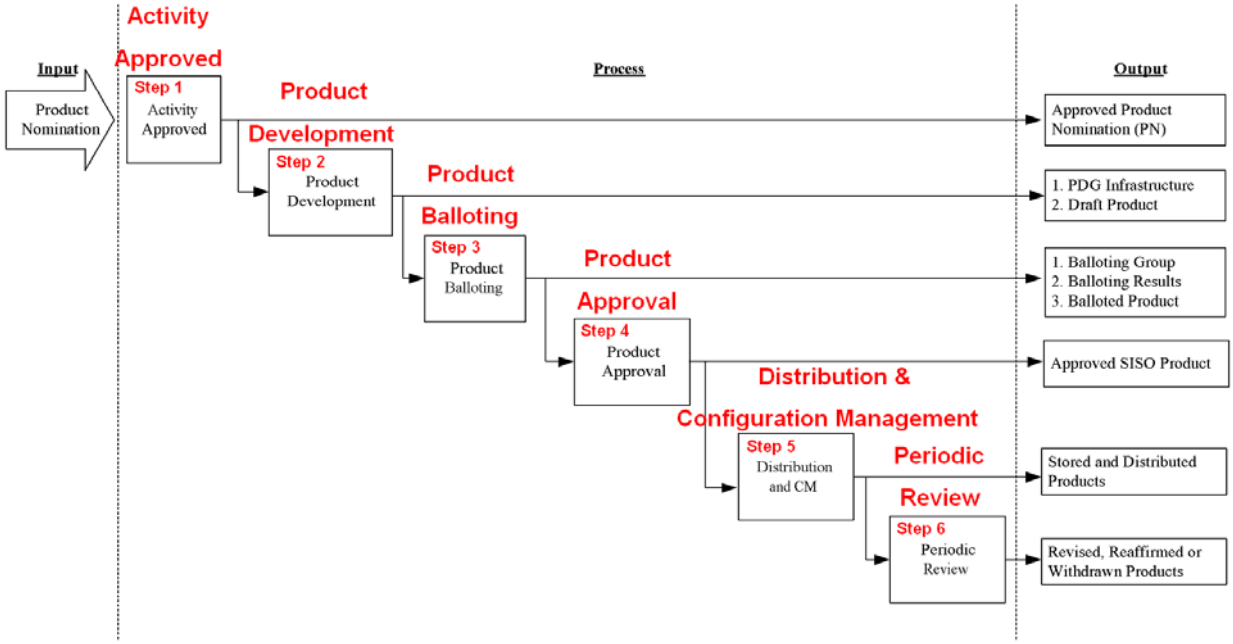

Figure 2. SISO Standards Development Process

HLA and DIS are particularly germane to this effort because of the focus on standards-based interoperability. HLA and DIS are the predominant simulation interoperability standards within military simulation. As such, any standard for SCORM-Sim interoperability although required to be independent of any single simulation interoperability standard, must work with these two extant standards at a minimum [11].

The effort described in this paper is being performed under the auspices of the SISO SAC. The process by which standards are developed under the guidance of the SAC is illustrated in Figure 2. Notice that the input that starts this process is a product nomination. A product nomination is created when a group of dedicated proponents determines that there is sufficient interest and technical grounding to produce a standard. In many cases, that determination is made through the efforts of a Study Group (SG) made up of such dedicated proponents who research and brainstorm the desirability and feasibility of a standard in a particular domain of simulation interoperability. This paper describes the efforts of such a group comprised of proponents with individual, but overlapping, experiences integrating simulations with SCORM-conformant instructional content.

Terms of Reference

When a SISO SG is established, the proponents must produce a Terms of Reference that describes the tasks and deliverables for the SG. The SCORM-Sim SG will execute the following tasks:

1. Call for position papers
2. Survey technical and pedagogical approaches taken to date
3. Determine where there is common ground
4. Discuss potential standardization efforts
5. Produce appropriate SISO Product Nominations (PNs) and/or Product Authorization Requests (PARs) for IEEE standards projects

Products resulting from the establishment and execution of the SCORM-Sim SG will include:

1. Compilation of position papers
2. Identification of potential standards
3. Multi-part PN/PAR for a set of standards whose development is seen as valuable and feasible
4. Final Report (the intent is to then turn this into a SISO Product Development Group(PDG) and/or IEEE Working Group)

USE CASES

Many of the position papers submitted to the group contain specific use cases describing previous and current efforts. In order to ensure we cover aspects of SCORM/Simulation integration that were not addressed in the papers, we developed generic use cases. The generic use cases were developed on two levels. The Basic level simply indicated that simulations can be "used" by SCORM content in three ways:

1. Simulation is used to demonstrate (Show Me)
2. Simulation is used for experiential learning (Let Me Try)
3. Simulation is used for testing (Test Me)

More specific generic instructional uses cases can be found in the group's document area on the SISO web site [12]. This document includes sixteen different ways in which the three basic cases can be implemented. The document also includes three or four uses cases for each of the users: Instructor; Instructional Designer (ID); Simulation Developer; Subject Matter Expert (SME); Content Developer; Simulation/LMS; Local Administrator(s); and Learner Using Simulation to Practice without Content.

TAXONOMY

Different communities of practice have very different ideas of what constitutes a simulation and how simulations should be incorporated into learning systems. Part of the effort of this study group is to develop a taxonomy of learning systems that incorporate simulations, often as part of a blended learning approach [13]. This taxonomy will help to determine what standards efforts for interfaces between a learning management system and a simulation will have the most impact. A taxonomy of these simulation-based learning systems may also help a potential learning system customer decide which standards are appropriate for the desired application.

The taxonomy characterizes training systems by a set of attributes, where each attribute has a finite set of possible values. These attributes are chosen to inform the standards required to implement the simulation and to interface the simulation to an associated learning environment. The taxonomy is represented by a decision tree where all the learning systems in a particular branch of the decision tree have the same attribute value. Thus selecting the values for a set of attributes determines a collection of possible training system configurations and the corresponding interface requirements. The attributes are grouped around three major themes:

- Learning System Functionality Attributes: These include individual or collective learners, interactive or display results simulation, support for instructor interactions with the learner and/or the simulation, and level of assessment automation.
- Human Computer Interface Attributes: These attributes describe requirements for learner and instructor control of the initial conditions for the simulation and for learner and instructor temporal control during the simulation.

- Operational Environment Attributes: These attributes describe requirements for how the learning system is configured in the learner's environment, particularly focusing on whether the learning system is distributed across a network or local to the learner and where the instructor (if any) is located.

REQUIREMENTS

Many of the position papers included requirements. A few of those requirements are summarized:

Stand-Alone Training

Customers require simulations that can be downloaded from the web and run stand-alone without concurrent access to the web as asynchronous training. However, they also want centralized student record-keeping. In this rapidly changing environment, they also want the training and simulations to be kept up-to-date.

Graduated Student Help

Customers want learning systems that provide various levels of student help. These levels are characterized in the Use Cases in terms of Show Me (Familiarization), Let Me Try (Acquire and Practice), Test Me (Validation), all of which require different levels of learner support [14,15].

Performance Assessment

Customers require learning systems that collect performance data based on student actions that can be uploaded to the web as evidence of competency. The performance data definitions (e.g., learning objectives) should be the same for live and simulation-based training. In particular, these requirements are defined by critical tasks needed within the simulation and by performance measures defined for these critical tasks.

Concurrent Assessment of Multiple Skills

Customers require simulations that provide the ability for students to demonstrate competency and the ability to integrate skills into performance on complex tasks. A single simulation session can provide feedback on multiple learning objectives [3,16,17,18,19]. The SCORM 2004 sequencing and navigation rules provide the methods for rolling up data on multiple learning objectives to provide an overall competency rating. However, it may take several simulation sessions to obtain all the data needed for an overall competency rating [5]. This may require use of global objectives, which SCORM 2004 provides [17,4].

Bookmarking

Customers require simulations that can be bookmarked to interrupt a session and then resume the session later. A key issue is where that data is stored. The context for bookmarking of interactive multimedia instruction (IMI) is significantly smaller than the context for a simulation.

OTHER APPLICABLE EFFORTS

There are several other efforts under the auspices of SISO that potentially have bearing on this effort.

- **Military Scenario Definition Language (MSDL)** - is intended to provide a standard mechanism for loading Military Scenarios independent of the application generating or using the scenario.

Standard MSDL is defined utilizing an XML schema thus enabling exchange of all or part of scenarios between (e.g.) Command and Control (C2) planning applications, simulations, and scenario development applications. Although MSDL is only applicable to military training applications, it could support courseware to analyze scenarios to dynamically select appropriate scenarios or to dynamically modify or create a scenario.

- **Coalition Battle Management Language (C-BML)** is an unambiguous language used to command and control forces and equipment conducting military operations, and to provide for situational awareness and a shared, common operational picture. C-BML could allow courseware to modify or create behaviors of other entities such as:
  - *threats* (e.g. varying shoot orders and weapon capabilities to adjust difficulty; or even adding or disabling anti-aircraft artillery (AAA) or Surface-to-Air Missile (SAM) site),
  - *virtual teammates* (e.g. a wingman), and
  - *coaching agents* (e.g. "follow me").
- Like MSDL, C-BML could also enable courseware to analyze the behaviors of the threats in the scenario to determine appropriateness to the student's current learning need.
- **The Extensible Modeling and Simulation Framework (XMSF)** is defined as a set of web-based technologies and services, applied within an extensible framework, that enables a new generation of modeling & simulation (M&S) applications to emerge, develop and interoperate. Because XMSF is, by definition, web-based like SCORM, there is a ready opportunity to integrate such simulations with SCORM with fewer of the interoperability issues associated with simulations designed for closed or stand-alone environments [20].

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- Carol Wideman, Vcom3D

And others we have missed in this list.

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NATO MSG Symposium on

"Transforming Training and Experimentation through Modelling and Simulation"

Rome, Italy, October 6, 2006

Interfacing Simulations with Training Content

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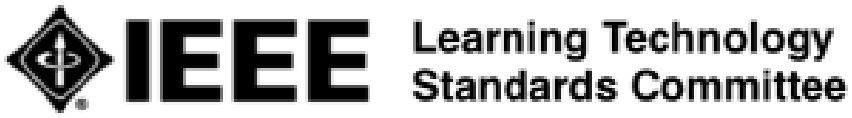
Presented by:

Jacqueline A. Haynes, Ph.D.

Intelligent Automation Inc.



Agenda

- The SISO SCORM-Sim Study Group
  - SISO Standards Process
  - Study Group Details
- SCORM-Sim Integration Challenges
- Study Group Scope & Products
- Use Cases
- Taxonomy
- Architectures & Topologies
- Notional Common Architecture & Stds.

SCORM-Sim Study Group

- Joint study group of SISO and the IEEE Learning Technology Standards Committee (LTSC)
- Formed to study standardization for the integration of simulation-based learning experiences with Sharable Content Object Reference Model (SCORM) environments

SISO Mission

SISO is dedicated to the promotion of modeling and simulation interoperability and reuse through the exchange of ideas, the examination of technologies, and the development of standards.

A discussion reflector for the group has been established at:
http://www.sisostds.org

LTSC Mission

The IEEE Learning Technology Standards Committee (LTSC) is chartered by the IEE Computer Society Standards Activity Board to develop accredited technical standards, recommended practices and guides for learning technology

Additional information can be found at:
http://ieeeltsc.org/wg11CMI/cmi-sim

IEEE Learning Technology Standards Committee

Standards Process:

- Study Group
  - Created as the result of a Terms of Reference (TOR)
  - Chartered to answer questions of interested
  - Generally have a limited life (~one year)
  - Can be the first step to a Product Development Group (PDG)
- Product Development Group
  - Created as the result of a Product Nomination (PN)
  - PDGs perform steps 2 & 3 of the BPDP
  - PDG Officers and the SAC perform step 4 of the BPDP
  - PDGs exist until the product is complete
- Product Support Group
  - Established once the PDG has completed development
    - Serve as the Interpretations Committee for IEEE standards
    - Responsible for steps 5 & 6 of the BPDP

Policies & Procedures
SISO SAC Groups

- Study Groups (SGs)
  - SISO SGs are created as the result of a Terms of Reference (TOR)
  - Chartered to answer questions of interest to the M&S community
  - Have a limited life; generally 1 to 2 workshop cycles
  - Expected to lead to a standards activity
  - Can lead to a
    - Standing Study Group (SSG) or
    - Product Development Group (PDG)

SCORM-Sim
Study Group

- Purpose
  - Investigate standard(s) for interfacing Simulations and SCORM-Conformant Learning Content
  - Enable SCORM content or Runtime Environments to invoke and communicate with simulations in a standardized and interoperable fashion
- Products
  - One or more Product Nominations (PNs) and/or Product Authorization Requests (PARs) based on:
    - Use Cases
    - Best Practices and Design Position Papers
    - Taxonomy of training simulation types
    - Recommendations on stds use and/or development
- Progress
  - Collected Position Papers, Uses Cases, Taxonomies
  - Identified Points of Interface
  - Identified existing standards

Organization

- Chair
  - ***Brandt W. Dargue***
    - *The Boeing Company, St. Louis, MO, USA*
- Vice-Chair
  - ***Geoffrey Frank, Ph.D.***
    - *RTI International, Research Triangle Park NC, USA*
- Secretary
  - ***Brent Smith***
    - *Engineering & Computer Simulations, Orlando, FL, USA*
- Technical Area Director
  - ***Katherine L. Morse, Ph.D.***
    - *SAIC, San Diego, CA, USA*
- Members
  - Registered on the PSG reflector
  - PSG may establish additional membership requirements with approval
  - PDG may allow new members to participate in business pending reflector registration

Other Position Paper Representatives

- Jack Hyde, AICC
- Avron Barr, Aldo Ventures, Inc.
- Bill Ferguson, BBN
- Robby Robson, Eduworks
- Luis Arguello, European Space Agency
- Bob Pokorny, Intelligent Automation Inc.
- Chris Bray & Susan Marshall, Joint ADL Co-Lab
- Brian Spaulding, MAK Technologies
- Michael Freeman, OSD
- Claude Ostyn, Ostyn Consulting
- Shane Gallagher, SAIC
- Jim Ong, Stottler-Henke
- Carol Wideman, Vcom3D

IEEE Learning Technology Standards Committee

Reflector Members

- Aoyama, Isao (i-aoyama)
- Barr, Avron (Aldo)
- Blackmon, Bill (ADL)
- Bray, Chris (ADL)
- Bukai, Ohad (IAI)
- Conkey, Curtis (NAVAIR)
- Dargue, Brandt (Boeing)
- DuBuc, Christopher
- Frank, Geoffrey (RTI)
- Furuichi, Masakazu
- Gallagher, Patrick
- Globe, James (L-3com)
- Haimson, Craig
- Hughes, Theresa
- Hyde, Jack (AICC)
- Lazarus, Richard
- Lier, Ad
- Lowe, Van (UCF)
- Marshall, Susan (ADL)
- McGarity, Michael ()
- Morissette, Garry (MAK)
- Myjak, Michael (Virtual Workshop)
- Oehlert, Mark (BAH)
- Ostyn, Claude
- Pittard, Bryan
- Prescott, Jonathan
- Robson, Robby (IEEE)
- Rouget, Chris (SISO)
- Smith, Brent (ECS)
- Spaulding, Brian (MAK)
- Travers, Virginia
- w, Albert (sedris)
- Zhang, Wei

SISO Technical Acceptance Principles

- Relevant
  - SISO Products will be relevant to the Modeling and Simulation Community.
- Substantive
  - SISO Products shall provide meaningful information and/or results.
- Timely
  - SISO Products will be produced in an efficient manner to ensure that the product is useful to the community.
- Community Review & Acceptance
  - SISO Products will be reviewed by the technical community to which the product applies. This may be a narrow niche or the community broadly defined.

SISO Balloted Product Principles

- Generality
  - Standards Products shall be as general as possible, while still maintaining usefulness, to support the broadest community of current and future users.
- Stability
  - Standards Products shall be established and changed only as necessary. They shall be prototyped and tested before being proposed for adoption to demonstrate their maturity.
- Supportability
  - Standards Products shall maintain the integrity of the existing product suite and the needs of the user.

Challenges

SCORM – Simulation Interoperability & Run-Time Issues

- How does a training simulation fit into the LMS/SCORM paradigm?
  - Non-Browser delivery environments
    - Software Distribution to Clients
    - Network Security within the DoD
  - Multiple simultaneous students (scheduling, lobby, etc…)
  - Two-way runtime communication with simulation
    - Rolling up simulation activity into assessment measures
    - Instructional intervention during simulation
      - Hints
      - Coaching
      - Intelligent Tutoring
    - After Action Review is an essential component of simulation-based training

Challenges (Continued)

- According to SCORM requirements, all communications with an LMS must be done through a standard API via an ECMAScript (JavaScript)
  - How do we facilitate communication between training simulation environment (native code) and JavaScript functions in LMS web page
  - What will this Communications layer will handle:
    - Initialization
    - Translation of simulation events into SCORM global objective data model elements (score, percent successful, percent complete)
    - Termination

Assessment

- SCORM specifies a simple model for identifying and tracking of training objectives:
  - Objective ID
  - Score (if applicable)
  - Success Status
  - Completion Status
- Training simulation assessment data must limit itself to the above general data elements in order for a SCORM compliant LMS to track it

Challenges (Continued)

- What is/are the architecture(s)
  - Is the SCO the correct integration point
- State saving in simulations
  - Is it done in the simulation or in the training system?
  - Can it be used to “replay” the student’ activities for an instructor?
- SCO granularity
  - Does 1 Simulation = 1 SCO?
- Starting up and shutting down (joining and leaving) simulations
  - Persistence
  - Initializing the scenario
- Launching and maintaining connectivity with multiple assets and/or SCOs
- What “counts” as a simulation in the instructional context?
  - “Taxonomy” of simulations
- Real time performance assessment
  - Where and how is assessment done?
  - Based on what data provided by whom?
- Individual vs. team training
  - Lobbying, event scheduling, discovery, coordination
- Security/policy
  - What types of assets can be downloaded
  - What types of connections are allowed (including ports)
- Is the sharing/reuse of simulation modules in or out of scope?

Terms of Reference (TOR)

- Call for position papers
- Survey technical and pedagogical approaches taken to date
- Determine where there is common ground
- Discuss potential standardization efforts
- Produce appropriate SISO PNs and/or PARs for IEEE standards projects

We are here!

Proposed Products

1. Compilation of position papers to develop
   1. Use Cases
   2. Common Architectural considerations
   3. Identify Key Interface Points
2. Identification of potential standards
3. Final Report (the intent is to then turn this into a SISO PDG and/or IEEE Working Group)

We are here!

IEEE Learning Technology Standards Committee

SISO

Use Cases:

- Use Case Spreadsheet
  - A survey to identify key interface points and supported use cases for each position paper
- Joint ADL Co-Lab developed use cases
  - Modified LSAL template use cases
  - “Lifecycle of learning” use cases
- AICC Simulation Topologies
  - Communication between the simulation and an Instructional Component
- Generic use cases
  - Courseware uses simulation
  - Simulation uses courseware

Instructional Use Cases

- Courseware (c/w) Uses Simulation
  - Show me
    - C/w controls (or replays) Sim to *demonstrate*
  - Teach me
    - Learner controls sim for *exploratory learning*
  - Let me try
    - Learner controls sim for *practice*
  - Test me
    - Student controls sim for *assessment*
  - **LMS*** initializes and receives scores from sim as activity node in course

- Simulation Uses Courseware As:
  - Prerequisite to sim
  - On-line help/hints
  - Remediation
  - Sim uses **LMS** * to store assessment of student in sim

Courseware (c/w) Uses Simulation

1. **LMS delivers c/w to student.**
   (a) Prerequisite training, (b) context/situation/scenario, (c) learning objectives

2. **C/w initializes simulation.**
   (a) Writes out IC* file; (b) loads sim if necessary; (c) establishes interface;
   (d) commands sim to IC

3. **Student interacts with simulation.**
   Options: (a) Student performs actions in sim;
   (b) Student observes sim "play out scenario;"

4. **Simulation sends student performance data to c/w.**
   Options A: (1) Instantaneous (real-time) or (2) "after action" log
   Options B: (1) Actions or results of actions sent to c/w to assess; (2) scores sent

5. **C/w sends assessment results to LMS.**
   (a) Immediately; (b) cached

6. **LMS selects and delivers appropriate content, repeating 1-5 as necessary.**
   Options A: (1) After action review; (2) remedial c/w
   Options B: (1) New scenario; (2) scenario adjustments
   Options C: (1) Sim stopped; (2) sim kept running;

*IC = Initial Conditions

A Taxonomy for Simulation-Based Training

User Multiplicity	Instructor Location WRT Student	Simulation Organization	Simulation Location WRT Student	Simulation Server Ownership	Network Ownership	Example Reference
Individual	Local	Centralized	Local	Shared	Shared	
Individual	Local	Centralized	Local	Shared	Dedicated	6.1
Individual	Local	Centralized	Local	Dedicated	Shared	
Individual	Local	Centralized	Local	Dedicated	Dedicated	6.2
Individual	Local	Centralized	Remote	Shared	Shared	
Individual	Local	Centralized	Remote	Shared	Dedicated	
Individual	Local	Centralized	Remote	Dedicated	Shared	
Individual	Local	Centralized	Remote	Dedicated	Dedicated	
Individual	Local	Distributed	Partly Local	Shared	Shared	
Individual	Local	Distributed	Partly Local	Shared	Dedicated	
Individual	Local	Distributed	Partly Local	Dedicated	Shared	6.3
Individual	Local	Distributed	Partly Local	Dedicated	Dedicated	6.4
Individual	Local	Distributed	Remote	Shared	Shared	
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Individual	Local	Distributed	Remote	Dedicated	Shared	
Individual	Local	Distributed	Remote	Dedicated	Dedicated	
Individual	Remote	Centralized	Local	Shared	Shared	6.5
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Individual	Remote	Centralized	Local	Dedicated	Dedicated	
Individual	Remote	Centralized	Remote	Shared	Shared	6.6
Individual	Remote	Centralized	Remote	Shared	Dedicated	
Individual	Remote	Centralized	Remote	Dedicated	Shared	
Individual	Remote	Centralized	Remote	Dedicated	Dedicated	
Individual	Remote	Distributed	Partly Local	Shared	Shared	
Individual	Remote	Distributed	Partly Local	Shared	Dedicated	
Individual	Remote	Distributed	Partly Local	Dedicated	Shared	
Individual	Remote	Distributed	Partly Local	Dedicated	Dedicated	
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Individual	Remote	Distributed	Remote	Shared	Dedicated	
Individual	Remote	Distributed	Remote	Dedicated	Shared	
Individual	Remote	Distributed	Remote	Dedicated	Dedicated	

Individual

User Multiplicity	Instructor Location WRT Student	Simulation Organization	Simulation Location WRT Student	Simulation Server Ownership	Network Ownership	Example Reference
Collective	Local	Centralized	Local	Shared	Shared	
Collective	Local	Centralized	Local	Shared	Dedicated	
Collective	Local	Centralized	Local	Dedicated	Shared	
Collective	Local	Centralized	Local	Dedicated	Dedicated	
Collective	Local	Centralized	Remote	Shared	Shared	
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Collective	Remote	Centralized	Local	Dedicated	Dedicated	
Collective	Remote	Centralized	Remote	Shared	Shared	
Collective	Remote	Centralized	Remote	Shared	Dedicated	
Collective	Remote	Centralized	Remote	Dedicated	Shared	
Collective	Remote	Centralized	Remote	Dedicated	Dedicated	
Collective	Remote	Distributed	Partly Local	Shared	Shared	6.6
Collective	Remote	Distributed	Partly Local	Shared	Dedicated	
Collective	Remote	Distributed	Partly Local	Dedicated	Shared	
Collective	Remote	Distributed	Partly Local	Dedicated	Dedicated	
Collective	Remote	Distributed	Remote	Shared	Shared	
Collective	Remote	Distributed	Remote	Shared	Dedicated	
Collective	Remote	Distributed	Remote	Dedicated	Shared	
Collective	Remote	Distributed	Remote	Dedicated	Dedicated	

Collective

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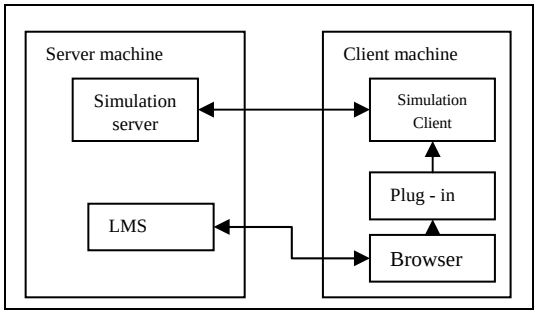
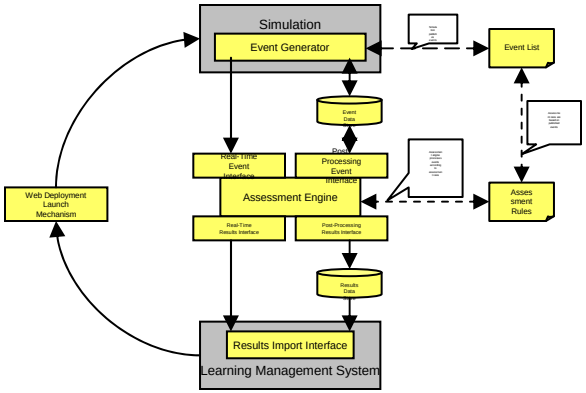
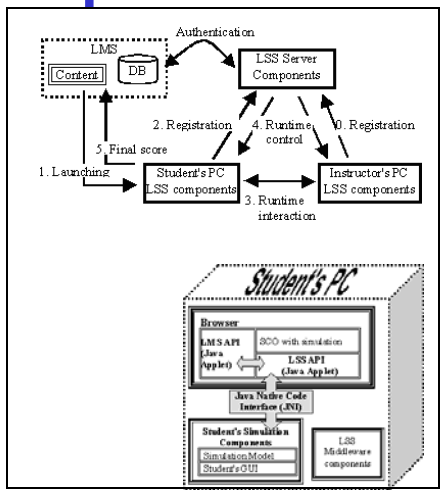
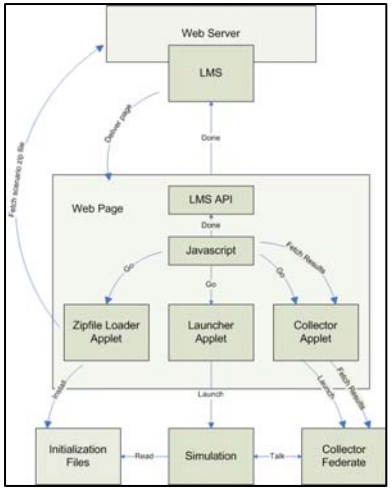
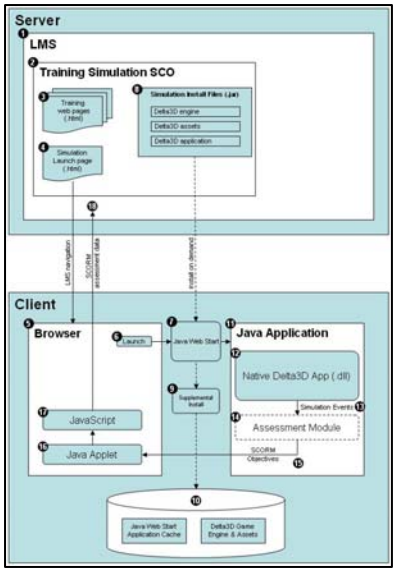
Architectures From Position Papers

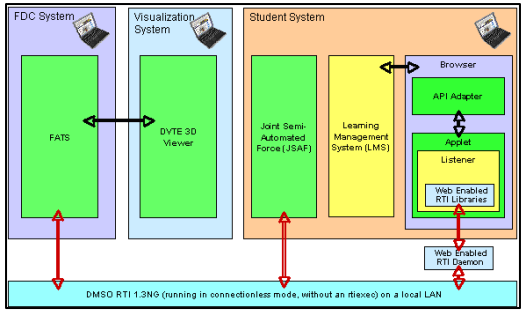


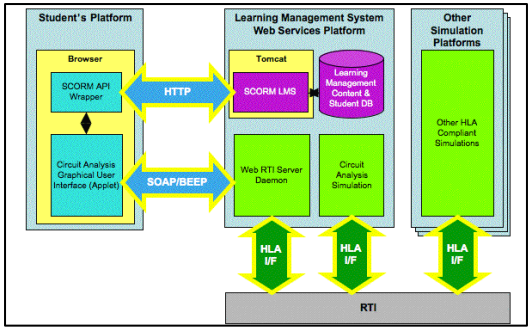












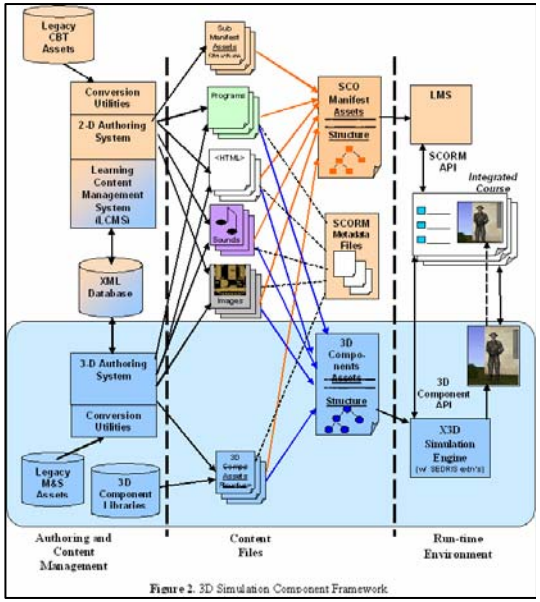


Figure 2. 3D Simulation Component Framework

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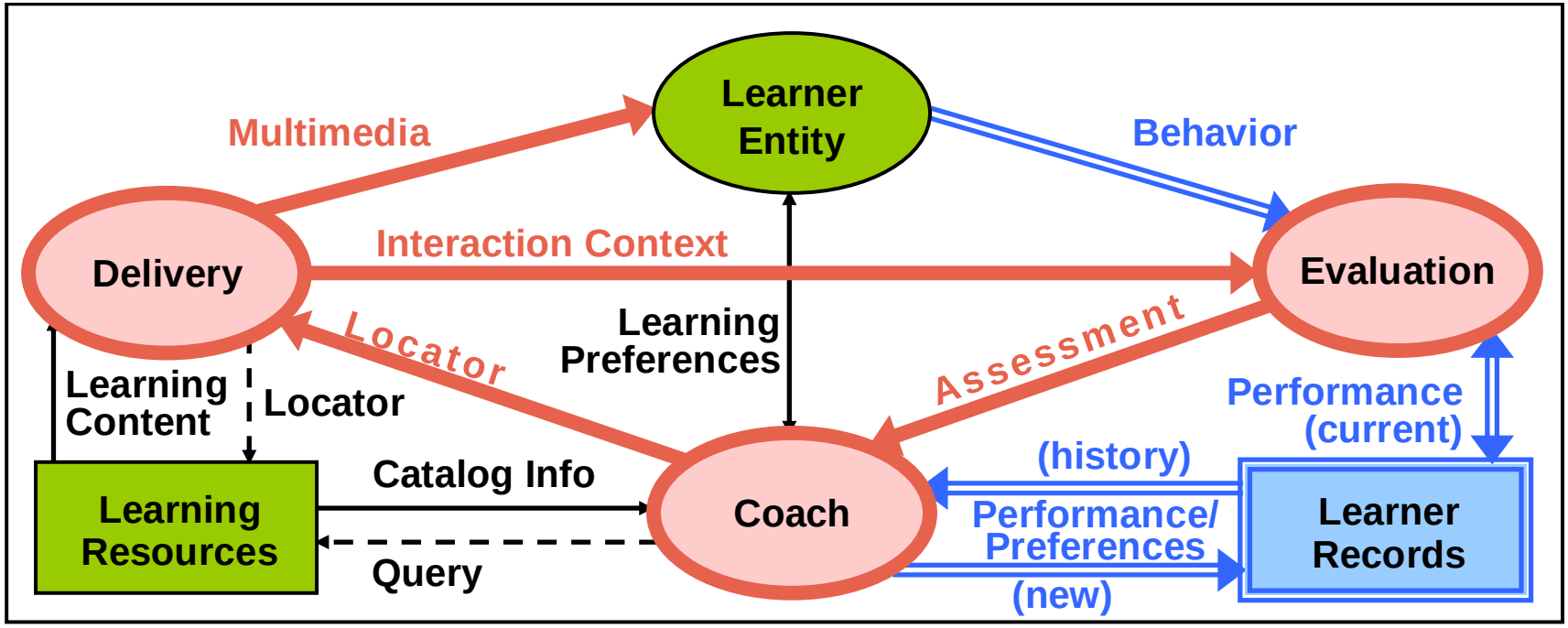
SISO

IEEE 1484.1 - Learning Technology Systems Architecture (LTSA)[1]



[1] *IEEE 1484.1* and *Learning Technology Systems Architecture* is copyright 2003 by the Institute of Electrical and Electronics Engineers, Inc., New York.

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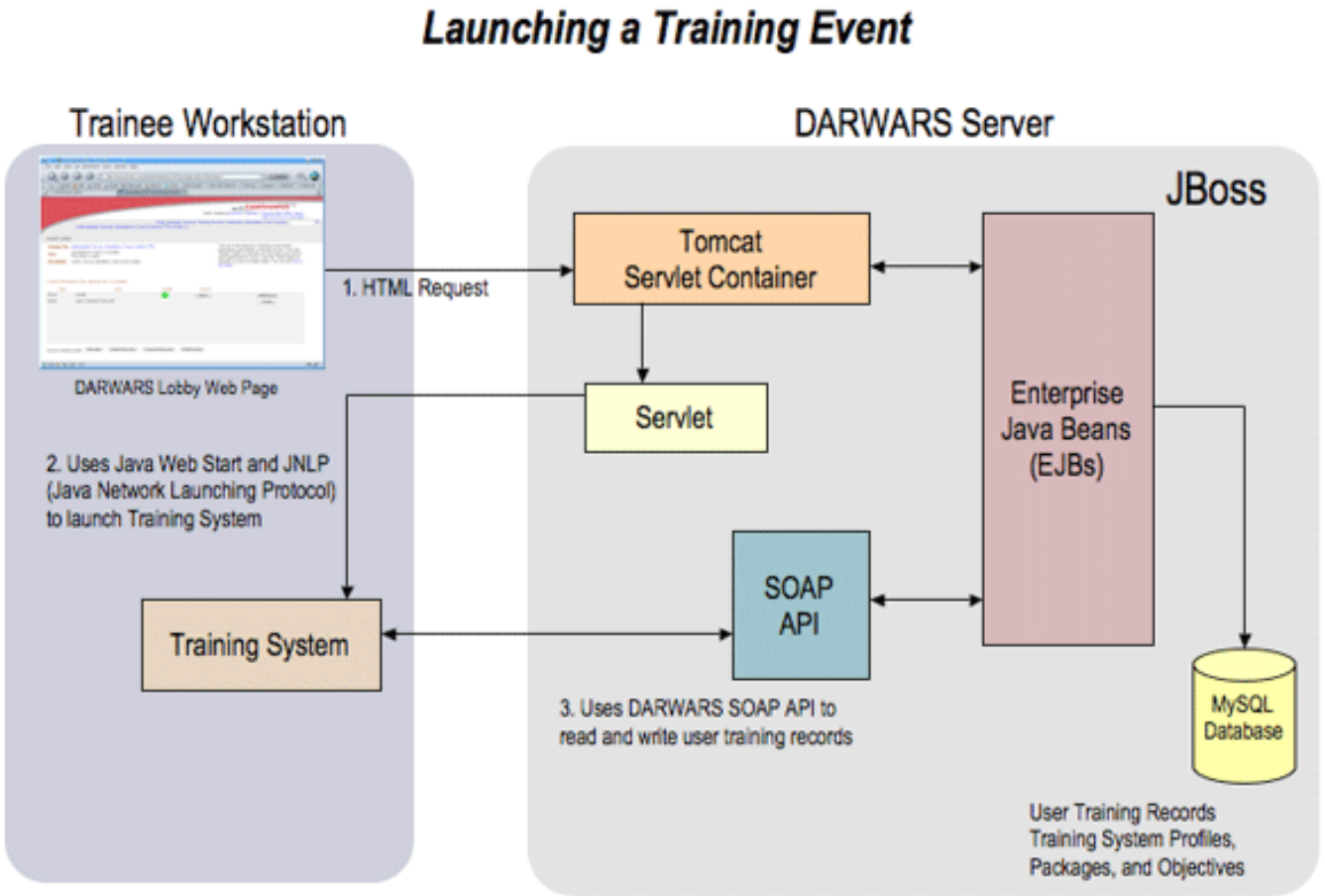
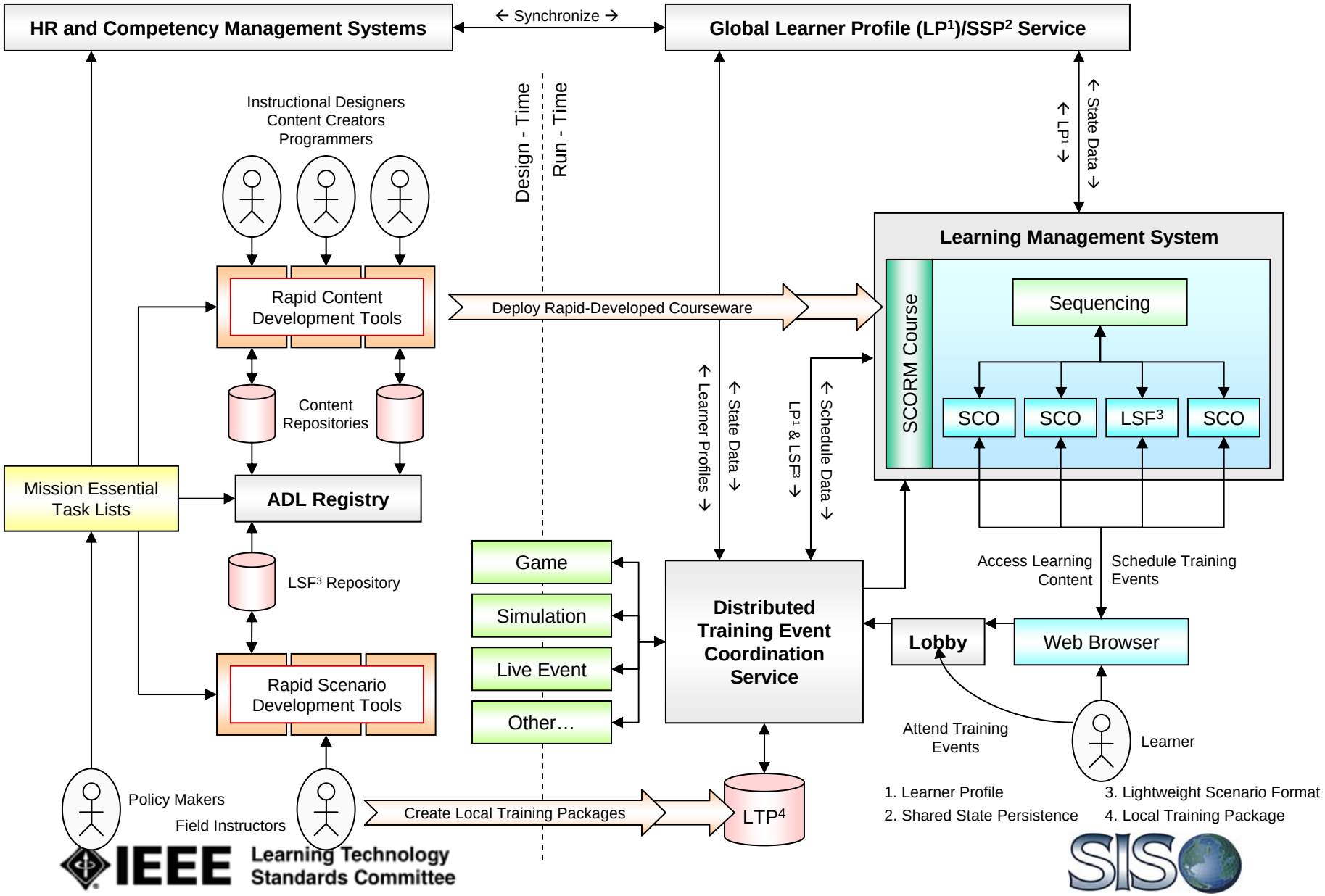
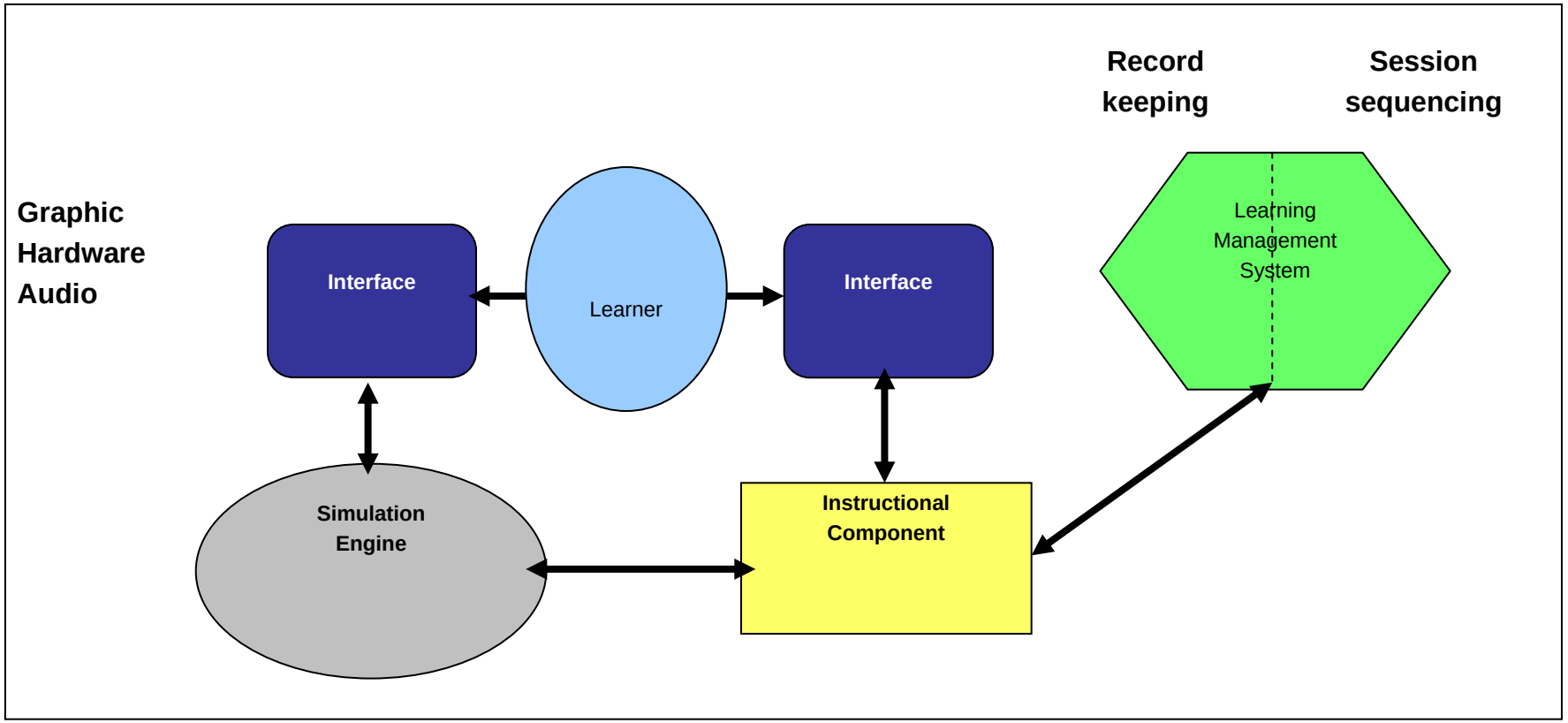
DARWARS Architecture



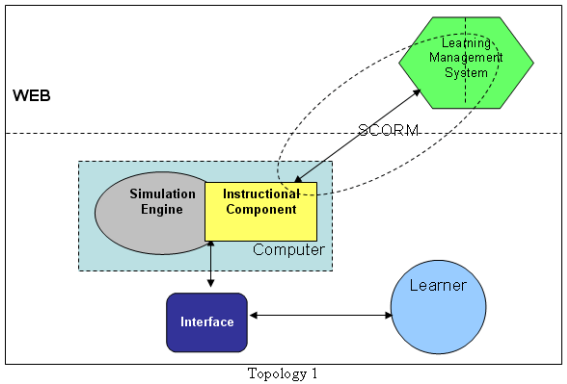
JADL 2012 Integrated Prototype Architecture (IPA) – Baseline Model



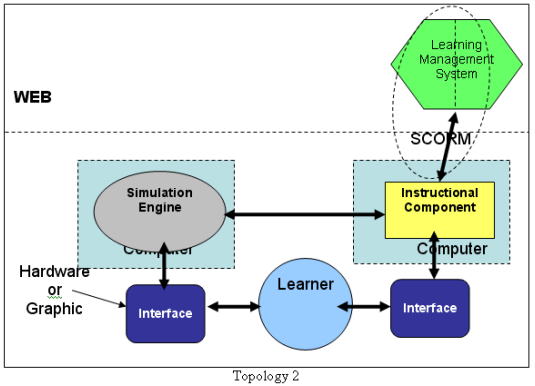
Topology Components



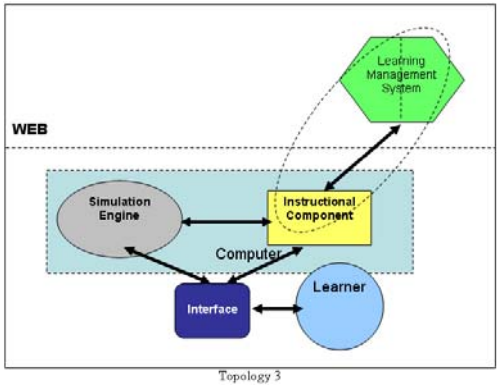
Topologies



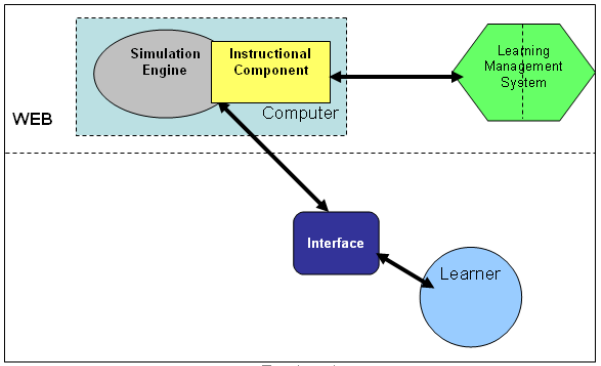
Topology 1



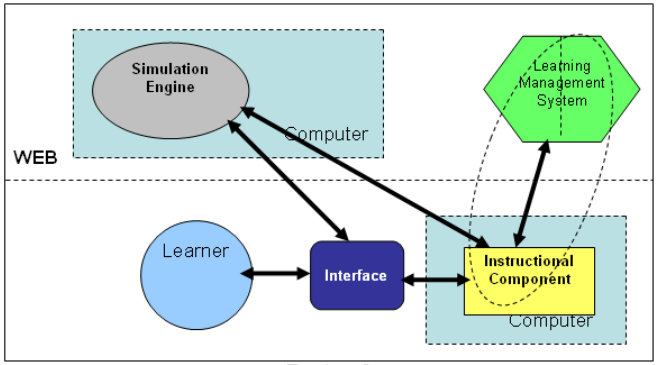
Topology 2



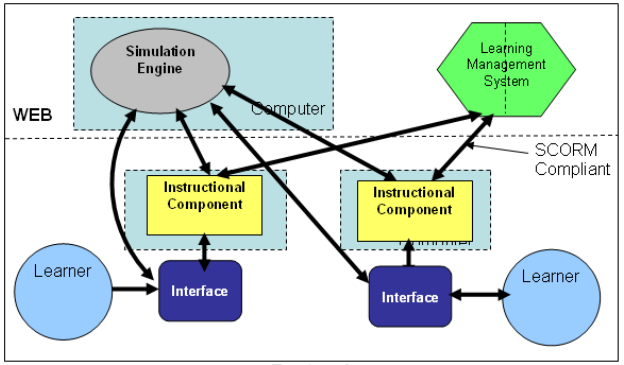
Topology 3



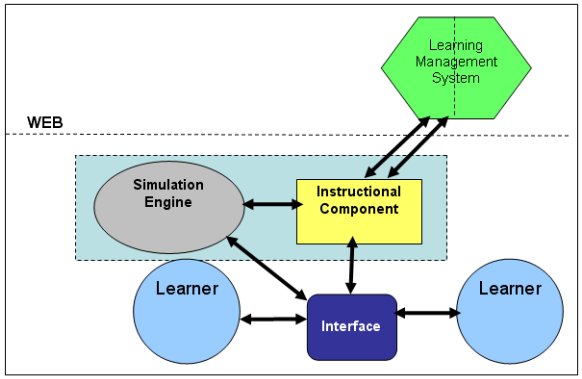
Topology 4



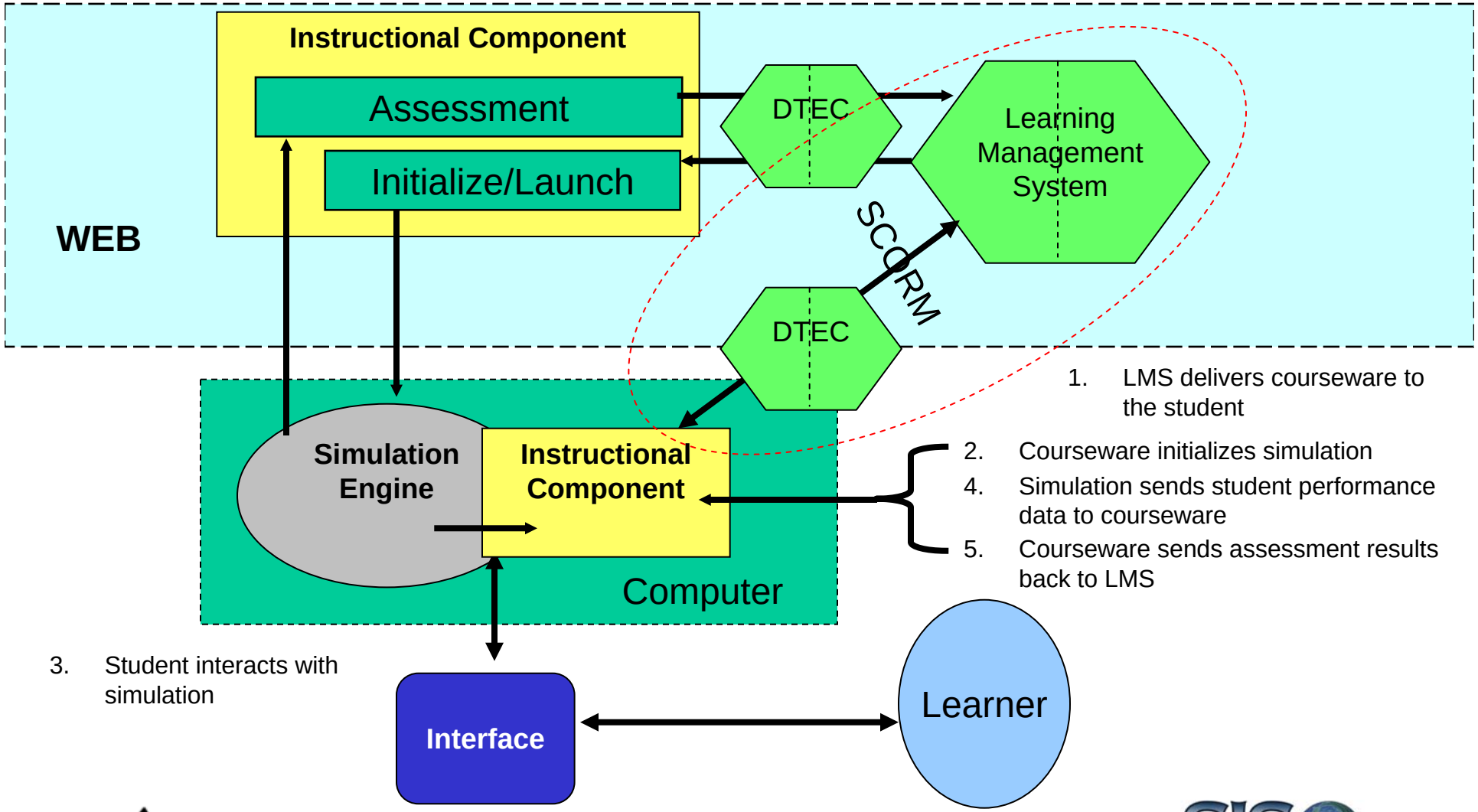
Topology 5



Topology 6



Topology 1 + DARWARS + Use Case?



1. LMS delivers courseware to the student
2. Courseware initializes simulation
3. Student interacts with simulation
4. Simulation sends student performance data to courseware
5. Courseware sends assessment results back to LMS

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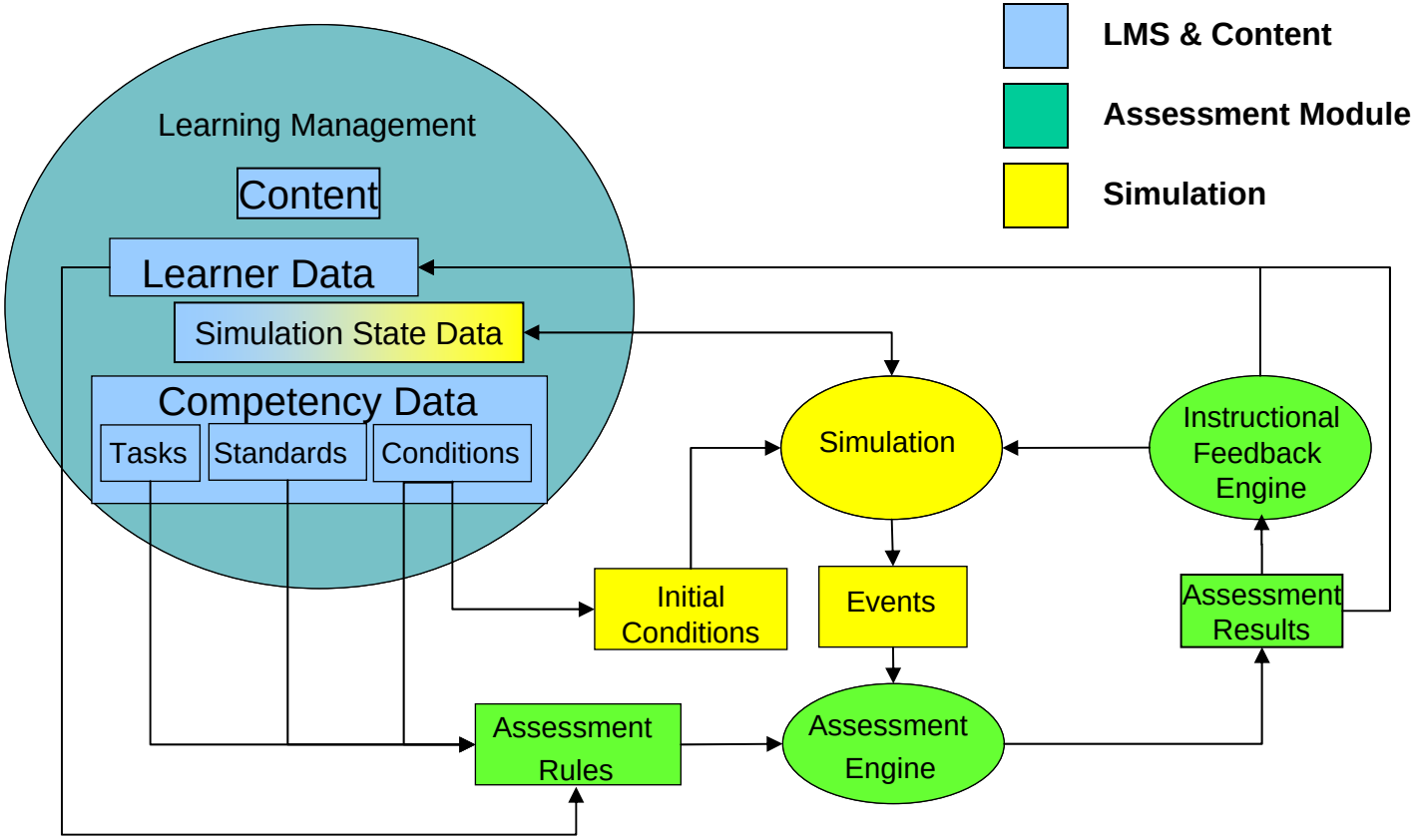
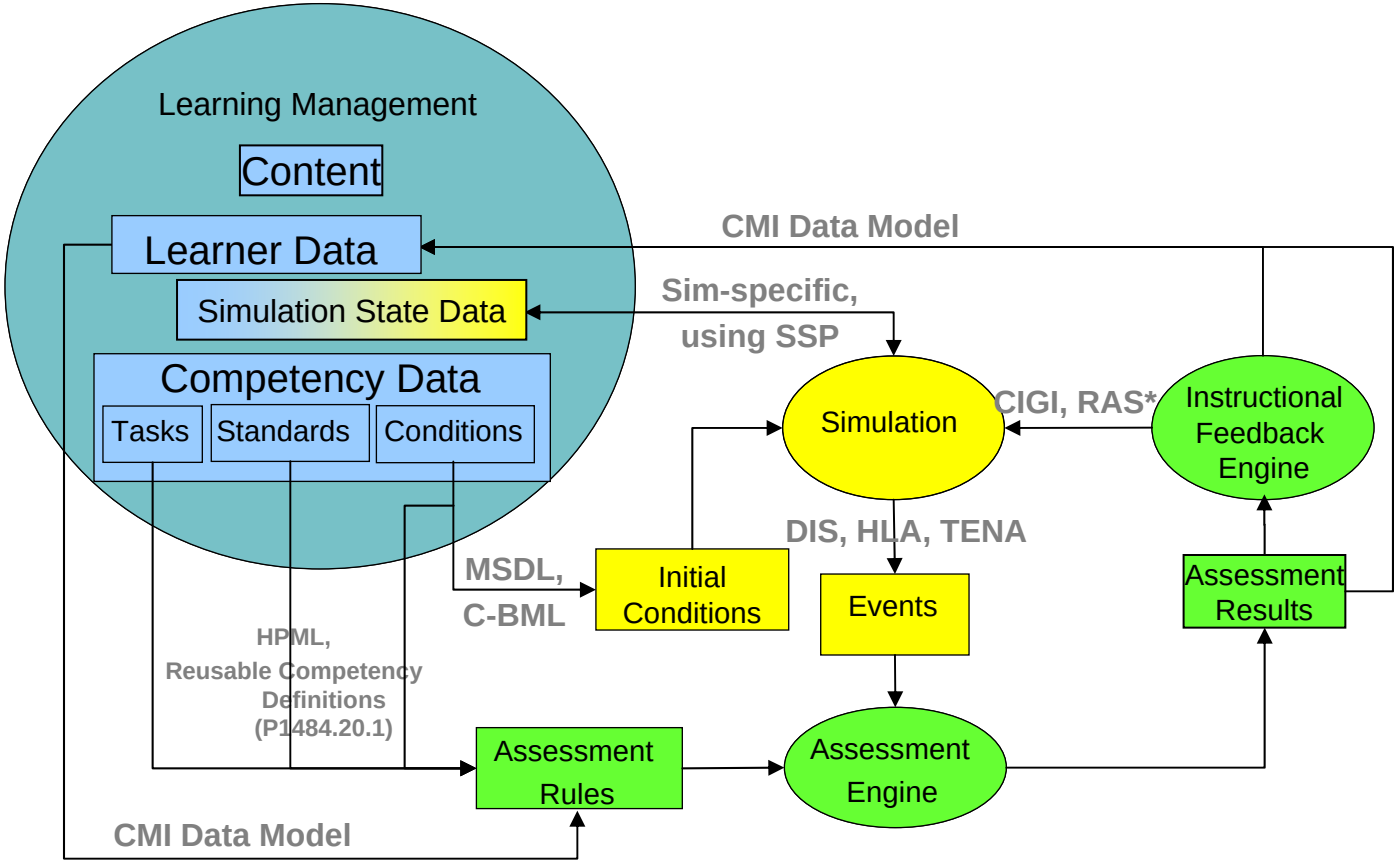
Notional Common Architecture



How Existing Standards/Specs Fit in the Architecture



* Remote Access Server – Citrix MetaFrame, Tarentella, SunRay

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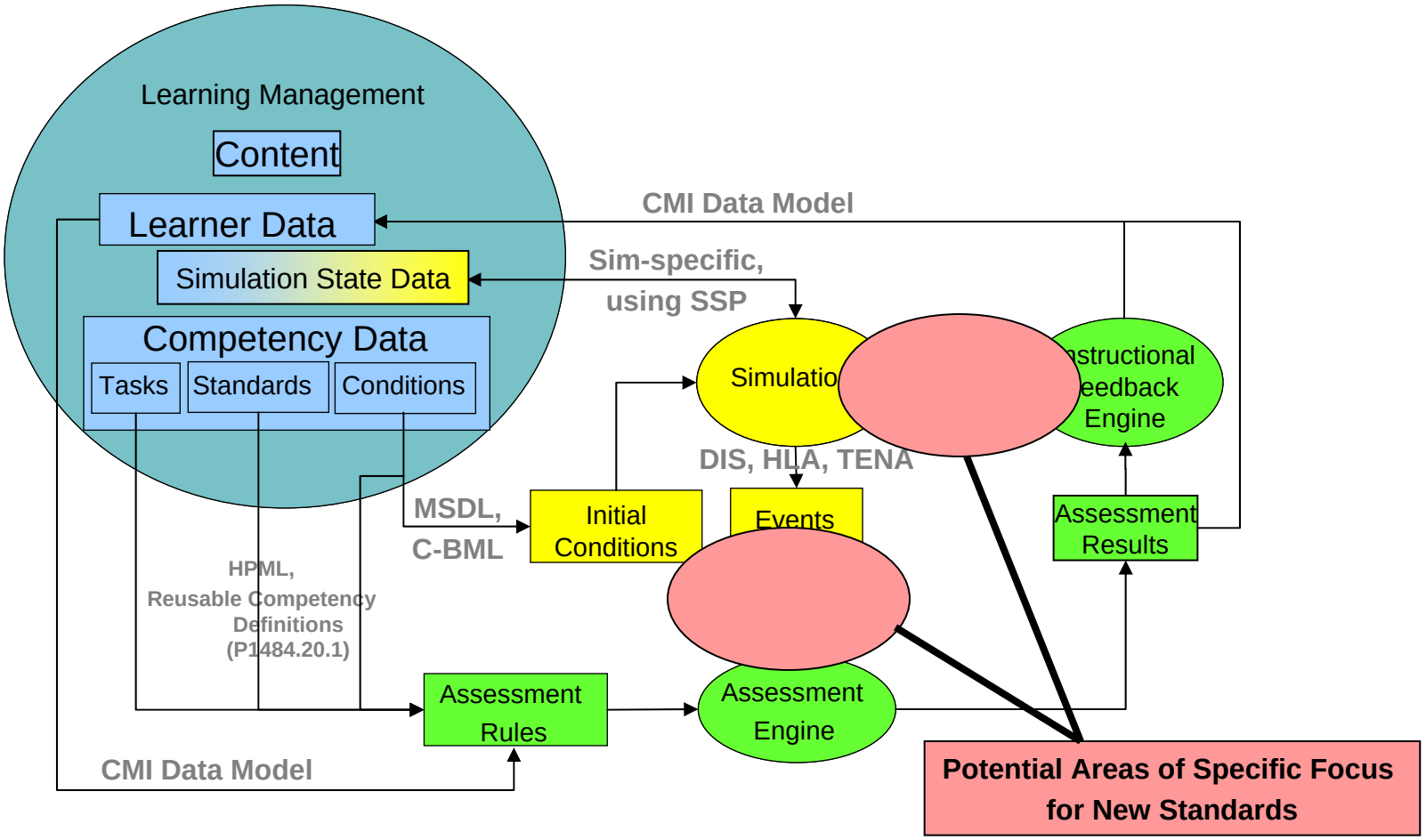
Areas of Focus